



SECTION 703

CONCRETE MASONRY CONSTRUCTION

703.1 Description. This work shall consist of constructing culverts, bridges and other structures of concrete, and the manufacture, transportation and erection of precast concrete slab units for bridges.

703.2 Material.

703.2.1 All material shall conform to Division 1000, Materials Details, and specifically as follows:

Item	Section
Bearing Pads	1038
Joints for Concrete Structures	1057.2
Joint Sealing Material	1057.2.6

All material, proportioning, air-entraining, mixing, slump and transporting of portland cement concrete shall be in accordance with [Sec 501](#) or [704](#), as applicable.

703.2.2 Changes in sources of cement and aggregates will be permitted only with the written approval of the engineer. Aggregates of essentially the same characteristics, except as noted in [Secs 1005.1.4](#) and [1005.2.3](#), and cements resulting in concrete of the same color, shall be used in any individual unit of the structure. The superstructure is considered an individual unit of the structure unless otherwise shown on the plans.

703.2.3 Concrete for precast slab units may be either Class A-1 or Class X concrete.

703.3 Construction Requirements.

703.3.1 Falsework. Falsework for concrete masonry construction shall be adequate to support and hold the forms true to lines, camber and grades shown on the plans. The contractor shall submit detailed plans for falsework, including supporting design computations. The engineer's acceptance of the plans will not relieve the contractor of the responsibility for obtaining satisfactory results. The falsework shall be constructed in general accordance with the submitted plans. The submittal of detailed falsework plans for small structures may be waived by the engineer. Falsework and forms for single and multi-span concrete frames and for continuous concrete slab and girder type bridges shall be provided for the full length of each continuous or monolithic unit and for the full width of the structure before starting concrete placement in that unit. Timber used in falsework shall be sound, in good condition, and free from defects which might impair its strength. Timber falsework piles shall be sound, reasonably straight, free from defects, and long enough to obtain the required bearing without splicing. They shall be accurately cut to the proper grade, and the use of shims or blocking shall be held to a minimum. Screw jacks shall be placed at approved locations to secure and maintain the required camber. Means shall be provided by the contractor for accurately determining settlement of the falsework while it is being loaded. The contractor shall furnish responsible personnel who shall correct the settlement by adjusting the

jacks. The personnel shall be on duty at all times while the falsework is being loaded and until settlement ceases.

703.3.2 Forms. Forms for concrete shall be built true to the lines and grades specified, and be mortar-tight and of sound material adequate to prevent distortion during the placing and curing of concrete. All concrete shall be formed unless otherwise specified. A concrete pad of approved thickness may be used as a form for the unexposed bottom of end bent beams on piles. No direct payment will be made for the concrete pads. Form work plans, if required by the engineer, shall be submitted by the contractor before form work is started. If during or after placing the concrete, the forms sag or bulge, the concrete affected shall be removed, the forms realigned and new concrete placed. Construction camber to take care of shrinkage or settlement impairing the strength of the structure by the reduction of depth will not be permitted. The forms shall be designed for a fluid pressure of 150 pounds per cubic foot (for a fluid density of 2400 kg/m^3) and, in addition, for a live load of 50 pounds per square foot (1.5 kPa) on horizontal surfaces and 30 pounds per square foot (1.5 kPa) on vertical surfaces for impact and vibration.

703.3.2.1 Face lumber of forms for exposed surfaces of concrete shall have a smooth dressed surface free of loose knots, knotholes and other defects. The spacing of supports and the thickness of face lumber shall be adequate to prevent distortion due to the pressure of the concrete. Face lumber shall have a minimum nominal thickness of one inch (25 mm) for solid lumber or 5/8 inch (16 mm) for plywood. Form material shall be placed with horizontal joints. Triangular moulding, smooth on three sides and having 3/4 inch (19 mm) width on each of the two form sides, shall be used to bevel all exposed edges of the structure, except where special bevels are shown on the plans.

703.3.2.2 Forms reused shall be in good condition. Form lumber which is unsatisfactory in any respect shall not be used.

703.3.2.3 Design and construction of forms shall permit their removal without damage to the concrete. Cofferdam braces or struts which will extend through any exposed concrete section will not be permitted. Forms under copings and around offsets may be given a draft of not more than one inch per foot (83 mm/m) to permit removal without damage to the concrete. For narrow walls where access to the bottoms of the forms is not otherwise obtainable, an opening shall be provided so that chips, dirt, sawdust or other foreign material may be removed immediately prior to placing concrete.

703.3.2.4 Interior forms for the top slab of box girder bridges, including their supporting joists and wales, may remain in place unless otherwise shown on plans.

703.3.3 Form lining will be permitted and will be required for exposed curved surfaces. Liners shall be of plywood or of an approved composition board and shall be at least 1/4 inch (6 mm) thick.

703.3.4 Fiber tubes for column forms above the ground line shall have a finish free of gaps or overlaps in the inside ply and shall be coated inside with a waterproofing material which will not stick or bond to or discolor the concrete surface of the column. Fiber tubes for column forms from 6 inches (150 mm) below the finished ground line down may show seams, shall be waterproofed and need not be removed.

703.3.5 Metal forms shall meet all the requirements of wood forms in so far as applicable and shall not be used except with permission of the engineer. If required by the engineer, detailed drawings of the proposed metal forms shall be submitted for approval. If wood forms are to be used in combination with metal forms, form details shall be submitted for approval. Steel

panels, or panels with metal frames and wood, which leave permanent impressions or ridges shall not be used except for concrete box culvert type structures and other non-exposed areas.

703.3.6 Oiling of the inside of all forms will be required except for those having composition linings. The oil used shall be a light, clear paraffin base oil or other approved material which will not discolor or damage the exposed concrete surface. The coating shall be applied before placing reinforcing steel.

703.3.7 Ties and spreaders and all metal appliances used inside of forms to hold them to correct alignment and location shall be so constructed that after removal of forms, the metal may be removed to a depth of at least one inch (25 mm) below the surface of the concrete. Metal tie rods used inside the forms where concrete will have an exposed surface shall be a type which will not produce a cavity at the surface of the concrete greater than 1 1/2 inches (38 mm) in diameter. Bolts and rods used as ties shall not be removed by pulling them through the concrete. Wire ties and pipe spreaders will not be permitted, and metal or wood spreaders which are separate from form ties shall be removed as concrete is being placed. A bolt-through method of supporting forms for massive substructure units may be used with the approval of the engineer. No form ties shall be embedded in concrete above the roadway surface on bridges except that coil ties and threaded rods may be permitted through the vertical face of the base and vertically through the top of barrier curbs. Coil ties and all metal to be embedded in barrier curbs shall be epoxy coated or galvanized.

703.3.8 Cavities produced by the removal of metal tie rods shall be carefully filled with mortar composed of approximately one part cement to two parts sand. White cement shall be added to the mortar if necessary to obtain the required color. In order to reduce the shrinkage, no mortar shall be placed in the cavities until 45 minutes after the initial mixing. In lieu of the above, any approved non-shrinking, non-staining type of mortar may be used. After the cavities are filled, the surface shall be left smooth, even and uniform in color and texture. Tie rod cavities in surfaces against which backfill is to be placed shall be filled with mortar or an approved plastic compound meeting the requirements of [Sec 1057.3](#). Patching of tie rod cavities in the interior surfaces of box girders will not be required.

703.3.9 Tubes for Voids.

703.3.9.1 Fiber tubes shall be properly designed for the use indicated and fabricated of spun-wound or laminated paper. The outside surface shall be waterproof. Tubes shall be stored under cover and kept off damp ground until ready for use. Distortion of the tubes shall be prevented during storage. The ends shall be covered with suitably designed caps which shall be mortar tight. If material used for capping tubes expands when moist, a preformed joint filler 5/16 inch (8 mm) thick shall be used around the perimeter of the caps.

703.3.9.2 Steel tubes shall have a minimum thickness of 0.024 inch (0.610 mm) and shall be designed for the use indicated and fabricated to ensure against damage or excessive distortion in handling, storage and placing. The diameter of the tube shall be as shown on the plans with a tolerance of plus zero and minus 3/4 inch (19 mm). The ends of tubes shall be covered with suitably designed metal end caps which are mortar tight.

703.3.9.3 Tubes for producing voids in concrete slab superstructures shall be accurately located in positions shown on the plans and shall be positively anchored to the joists carrying the floor forms. Anchors and ties shall be designed to leave a minimum of supporting material exposed in the bottom of the finished slab of the completed structure. Details of proposed anchorage and ties for the tubes shall be submitted for approval before work is started on the bridge superstructure. One 3/4-inch (19 mm) weephole shall be provided near each end of each tube. Weepholes shall be placed in straight lines parallel to bents. They shall extend through the forms and be kept open at all times. Tubes shall be protected from moisture and

heat until concrete is placed. Distortion of tubes after placing of concrete shall not increase their vertical axis by more than 1/2 inch (13 mm).

703.3.10 Falsework and form removal from under any structural concrete unit shall not be started until the concrete has attained at least the compressive strength shown in [Table I](#). The falsework support of all concrete spans of a continuous or monolithic series, shall be first released from the center of all spans, and shall proceed simultaneously from all span centers each way toward adjacent bents. Release shall be in such manner as to permit the concrete to gradually and uniformly take stresses due to its own weight (mass).

TABLE I	
Class of Concrete	Compressive Strength psi (MPa), min
B	2750 (19)
B-1	3000 (21)
B-2	3000 (21)
X	3000 (21)

Compressive strength will be determined by tests made in accordance with MoDOT methods.

703.3.10.1 Except as provided in [Sec 703.3.17](#), forms for vertical surfaces of bridge superstructure shall be removed as soon as the concrete is self-supporting, generally within 24 hours after placement, to permit prompt patching of tie holes.

703.3.11 The forms for precast slab units shall be placed on a rigid, level, smooth base and shall be sufficiently rigid in themselves that there will be no movement of the forms during the placing and the setting of the concrete. Unless the concrete is steam cured in accordance with [Sec 703.3.17](#), removal of non-prestressed precast slab units from casting beds shall not begin for at least 48 hours after the casting. In addition, whether cured by steam or other means, removal shall not begin until a compressive strength of 1500 pounds per square inch (10.5 MPa) for Class A-1 concrete, and 1200 pounds per square inch (8.3 MPa) for Class X concrete has been attained. Curing shall be continued for at least 24 hours after a compressive strength of 2400 pounds per square inch (16.5 MPa) for Class A-1 concrete, and 2000 pounds per square inch (13.8 MPa) for Class X concrete has been attained. Precast units shall not be transported or erected until at least 7 days after casting and then only if the stipulated strength for curing has been attained.

703.3.11.1 Concrete Testing Equipment. Equipment for field determination of compressive strength of concrete shall be furnished by the contractor at the location of manufacture of precast slab units. The testing machine may be of any mechanical or hydraulic type capable of applying and measuring the required load and shall comply with the accuracy tolerances and corrections specified in AASHTO T 67, Section 16.1 and Section 17. Approximately the last one-half of the load shall be applied at a rate of between 1200 and 3000 pounds per square inch (8 and 21 MPa) per minute. The contractor shall furnish a sufficient number of compression test cylinder molds of a type meeting the approval of the engineer. The contractor shall furnish sufficient personnel for cleaning and preparing reusable molds.

703.3.12 Placing concrete in any unit of a structure shall not begin until preparations for placing and finishing are satisfactory to the engineer. Concrete shall be placed in the form in layers as near final position as practicable with minimum handling. Each placement shall be completed in a continuous operation with no interruption in excess of 45 minutes between the placing of contiguous portions of concrete. Where a finishing machine is to be used, it shall be moved over the area to be finished, immediately prior to placing concrete in any bridge deck pour, to facilitate checking reinforcement cover and slab thickness. This checking shall be made in the presence of the engineer and with the screeds in the finishing position. Placing

of concrete for bridge decks shall proceed uniformly for the full width of the placement. Once begun, placing of concrete in the superstructure of a continuous or monolithic series of spans shall proceed as rapidly as good construction practice will permit until all the concrete in that series is placed. Vibrators having a minimum frequency of 4500 impulses per minute shall be used to thoroughly consolidate the concrete in the forms and around the reinforcing steel. Sufficient vibrators shall be on hand to ensure continuous placement of the concrete without delay. They shall not be used for moving concrete from place to place nor shall they penetrate or disturb previously placed layers of concrete which have taken initial set. Vibration shall not be prolonged until it causes segregation of the material. Reinforcing steel protruding through transverse or longitudinal headers shall not be disturbed until the concrete is at least 24 hours old.

703.3.12.1 Where placing operations involve dropping the concrete more than 5 feet (1.5 m), the concrete shall be deposited through vertical sheet metal or other approved pipes. These pipes shall be made in sections not to exceed 4 feet (1.2 m) long. In chutes, the velocity of the concrete shall be retarded by the use of baffles or chokers, or by the use of a series of short chutes to reverse the direction. Open troughs and chutes shall be either metal or metallined. Where concrete is placed in the interior of pneumatic caissons, it may be deposited through air locks or other approved devices, and the requirement of dropping the mixture not more than 5 feet (1.5 m) will be waived.

703.3.12.2 Concrete shall be worked under and around the reinforcing steel without displacing the steel. Forms and reinforcing steel above concrete being placed and placing equipment shall be kept clean and free from coatings of hardened concrete. Water used for flushing the equipment shall be discharged clear of the concrete and forms.

703.3.12.3 Concrete shall be placed around the tubes forming voids in slab spans using methods to prevent the displacement of the tubes. For tubes having an inside diameter greater than 14 inches (350 mm), the concrete shall be placed in three layers. The first layer shall extend from the floor forms up to a plane 1/4 tube diameter above the bottom of the tubes and the second layer to 3/4 tube diameter. For tubes 14 inches (350 mm) or smaller, the concrete shall be placed in two layers, with the lower layer extending to the middle of the tube. Each layer, after placing, shall be vibrated and allowed to settle before the next succeeding layer is placed, which layer shall be deposited while the concrete in the layer below is still plastic enough to permit intermixing the two layers by use of a vibrator.

703.3.12.4 The sequence of placement of concrete for roadway slabs on a continuous series of spans will be shown on the plans together with the minimum rates of placement required for the basic sequence and for combinations thereof. The contractor shall observe the basic sequence of placement unless the contractor can demonstrate that the contractor can place and satisfactorily finish combined placements at the required rate. If the contractor wishes to alter the placing sequence or to combine units, the contractor shall submit a request for approval in writing.

703.3.12.5 Concrete for substructure units shall be placed in the dry unless otherwise authorized by the engineer. If the supporting material at plan elevation of the bottom of a pile footing is not sufficiently stable to support the concrete it shall be stabilized, or the bottom of the footing shall be formed to adequately support the concrete. No direct payment will be made for the stabilizing of material or forming under pile footings.

703.3.12.6 Depositing concrete under water will be permitted if provided for in the contract or upon written approval of the engineer. The concrete shall be placed by tremie bottom dump bucket or mechanically applied pressure. The tremie shall consist of a tube having a diameter of not less than 10 inches (250 mm) and shall be equipped with a hopper of suitable capacity. The bottom dump bucket shall have a capacity of not less than 1/3 cubic yard (0.25 m³). The

concrete shall be placed in its final position in still water and shall not be vibrated or disturbed after being deposited. Concrete placed under water and for seal courses shall be Seal concrete in accordance with [Sec 501](#).

703.3.12.7 Conveying or pumping equipment shall have adequate capacity, be suitable for the intended work and be so operated as to produce a continuous stream of uniform concrete. It shall be arranged to prevent transmission of vibration to freshly placed concrete. The system through which the concrete is pumped shall be manufactured so that no aluminum parts will come into contact with the concrete.

703.3.12.7.1 Equipment provided for conveying and placing concrete by mechanically applied pressure shall have adequate capacity and be suitable for the intended work. It shall be so operated as to produce a continuous stream of uniform concrete. The system through which the concrete is pumped shall be manufactured so that no aluminum parts will come into contact with the concrete.

703.3.12.7.2 At the completion of concrete placement, the last concrete used from the pipeline shall be ejected in a manner that will prevent contamination or segregation of the concrete.

703.3.12.8 Concrete used for filling cavities or crevices as authorized by the engineer and as required in [Sec 206.4.2](#) shall be Class B concrete. This concrete shall be unformed mass concrete placed separately from and prior to the placing of footing concrete.

703.3.13 Construction and expansion joints in concrete masonry shall be located where shown on the plans except that in case of an unforeseen contingency, an emergency construction joint may be permitted. Surfaces of construction joints shall be roughened or scored unless shear keys are shown on the plans. The face edges of all joints shall be carefully finished, and feather edges shall be avoided. When the placing of concrete is temporarily discontinued, the concrete after becoming firm enough to retain its form shall be cleaned of laitance and other objectionable material, and shall be thoroughly wetted before placing new concrete. Contraction joints in floor slabs of truss bridges may be sawed. Waterstops and flashings as shown on the plans shall be continuous if practicable. If splices are shown on the plans or permitted by the engineer, they shall be watertight.

703.3.13.1 Preformed sponge rubber expansion joint material shall be of the dimensions shown on the plans. Splices shall be held to a practicable minimum and shall be made by lacing with copper wire or soft-drawn galvanized steel wire. All joint material shall be securely stitched to one face of the concrete with No. 10 gage (2.588 mm) copper wire or No. 12 gage (2.692 mm) soft-drawn galvanized steel wire. Unless joint sealing is specified, the sponge rubber material shall be left exposed for its full length with clean and true edges.

703.3.14 Riding surfaces shall be finished true to the alignment, grade, cross section and camber shown on the plans. These surfaces shall be finished by use of an approved mechanical finishing machine. On skewed structures the finishing machine shall be adjusted to finish the surface approximately parallel to the skew if the angle of skew exceeds 45° or if the angle of the skew exceeds 30° and the placement width divided by the span length equals or exceeds 0.8. Use of vibratory screeds will not be approved whether or not they are a part of the proposed finishing machine.

703.3.14.1 Machine finishing shall be with an approved self-propelled mechanical finishing machine. The engineer may waive its use on isolated irregular shaped areas of the bridge surface. The finishing machine shall travel on adjustable rails or guides set to proper grade, and supported outside the limits of the finished riding surface. Where a longitudinal joint is shown on the plans, the finishing machine rails or guides shall be placed as close as practical

to the longitudinal joint. The rails shall be supported to limit the full operating load deflection between supports to 1/8 inch (3 mm) or less. They shall in general be placed parallel with the centerline of roadway or the longitudinal axis of the area to be finished. Where supports are so located that fresh concrete must be placed around them, the rails or guides shall be furnished in sections of 10 feet (3 m) or less and placed above the concrete surface. The sections and supports shall be removed and the holes filled with concrete immediately after the final straightedging. The finishing machine shall make sufficient passes to obtain the specified cross section and surface finish. The final pass of the machine shall be of maximum practicable length and shall be coordinated with the rate of placement. Finishing machine loads will not be permitted on concrete less than 48 hours old.

703.3.14.2 Where hand finishing of riding surfaces is permitted, the surface shall be struck off to the design section by a rigid metal shod template. The template shall be supported on rails or guides that can be adjusted to produce the design section and slab thickness. The rails or guides shall be supported above or outside the concrete surface. The surface behind the template shall be finished with a longitudinal float. The longitudinal float shall have a rigid metal shod smoothing surface which is a true plane not less than 10 feet (3 m) long and 8 inches (200 mm) wide. The float shall be operated from movable bridges with a combined longitudinal and transverse motion. Each transverse pass shall overlap the previously floated area by approximately one-half the length of the float.

703.3.14.3 Sufficient work bridges shall be provided to complete the work in an orderly and continuous manner. Work bridges shall be supported outside the limits of concrete placement.

703.3.14.4 Straightedging. The riding surface shall be checked with a 10-foot (3 m) straightedge immediately after the final finishing operation. The straightedge shall be pulled lightly across the surface from one edge of the finished area to the other without interruption. Reaching from outer edges to the center of the finished area will not be permitted. Each transverse pass shall overlap the previously straightedged portion by approximately one-half the length of the straightedge. The straightedge shall not be used to cut or move concrete from its finished position. Any irregularities, bumps or improperly finished areas shall be refinished and the surface again checked by repeating the straightedging operation.

703.3.14.5 Roadway Finish Texture. The roadway surface, except within 12 inches (300 mm) of the inside face of the curb, shall be textured as soon as the condition of the concrete will permit. The roadway finishing shall otherwise conform to the applicable portions of [Sec 502.10.3](#). Hand operated devices producing a satisfactory texture will be permitted. At the contractor's option a finned float with a single row of fins may be used. The grooves produced by the finned float shall be approximately 1/8 inch (3 mm) in width at 5/8 inch (16 mm) to 3/4 inch (19 mm) centers and be approximately 1/8 inch (3 mm) deep. This operation shall be performed at such time and in such a manner that the desired texture will be achieved while minimizing displacement of the layer aggregate particles.

703.3.14.6 Surface Test. As soon as curing has been completed, the riding surface will be thoroughly straightedged by the engineer and all variations exceeding 1/8 inch (3 mm) in 10 feet (3 m) will be plainly marked. Areas more than 1/8 inch (3 mm) high shall be removed by an approved device consisting of multiple cutting edges leaving a grooved surface finish comparable to that produced by the broom. The use of a bush hammer or other impact device will not be permitted.

703.3.14.7 Unless an armored joint is shown on the plans, construction and expansion joints in the roadway surface shall be carefully edged and left free of all mortar and concrete. These joints shall be sealed with joint sealing material if shown on the plans. Joints shall be dry and shall be cleaned immediately before they are sealed. Required joint sealing shall be done prior to surface sealing the bridge deck.

703.3.15 Surface finish for concrete masonry units, other than those specified in [Sec 703.3.14](#), shall begin immediately following removal of the forms. Fins and irregular projections shall be removed. Form tie cavities, holes, honeycomb spots in other than exposed surfaces, and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed with a mortar in accordance with [Sec 703.3.8](#). Repaired surfaces shall be satisfactorily cured.

703.3.16 Bridge seats shall be finished with a wood float to a smooth even surface. Where lead plates or fabric pads are used to seat steel bearing plates, the area under the lead plates or fabric pads shall be finished to within 1/8 inch (3 mm) above plan elevation and shall be dressed to a uniform, level bearing with a Carborundum brick or power grinder after the concrete has set sufficiently to fix the larger particles of sand. The deviation of the bearing seat from a true level surface shall not exceed 1/16 inch (1.5 mm). Where elastomeric bearing pads are used, the finishing of 1/8 inch (3 mm) above plan elevation and grinding of the bridge seat area will not be required. Wells for anchor bolts shall be completely filled with an expansive type mortar meeting the requirements of [Sec 1066](#) after the steel has been erected and adjusted. In lieu of wells, anchor bolt holes may be drilled in accordance with [Sec 712.6](#). Keyways, anchor bolt wells and holes, and other depressions which might collect water and freeze shall be sealed.

703.3.17 Curing. Curing of exposed concrete masonry surfaces shall be in accordance with [Sec 502.12](#) except as follows: Riding surfaces and other surfaces to be surface sealed shall be cured with mats of jute, cotton or other suitable fibers. Curing mats shall be applied as soon as the concrete has set sufficiently that no marring of the surface or distortion will result. The mats at the time of placement shall be sufficiently wet to prevent moisture absorption from the finished surface. The mats for curing riding surfaces shall be kept continuously wet by use of a sprinkler, soaker hose or similar means until the concrete has attained at least the compressive strength shown in [Table I](#), but in no case for less than five days. The mats for curing other surfaces shall be kept continuously wet for 72 hours. The mats shall then remain in place until they are dry or, if not dry, for at least 24 hours after the end of the wet curing period. Surfaces to be dampproofed, and railroad bridge decks to be waterproofed, shall not be cured with membrane. Such surfaces may be cured by the use of the prime coat specified in [Sec 708.3.2](#). Other exposed surfaces shall be cured by covering with transparent membrane applied in accordance with the requirements of [Sec 502.12.1](#), or by the use of wet burlap. If permitted by the engineer, footings may be cured by submersion.

703.3.17.1 Steam curing or curing by complete submersion in water will be permitted for precast members. If steam curing is applied, the jets shall not impinge directly on the concrete or on the forms; free circulation around the units shall be maintained; the steam shall be thoroughly saturated at all times; the temperature around the concrete shall not be raised more than 40 F (20 C) per hour and shall not exceed 160 F (70 C) at any time. After the expiration of the steam curing period, the temperature inside the chamber shall be reduced at a rate of not more than 40 F (20 C) per hour until a temperature has been reached about 20 F (10 C) above the temperature of the air to which the concrete will be exposed.

703.3.17.2 Curing concrete for box girder superstructures shall begin as soon as possible after completion of each concrete placement. Wet mats shall be used for curing the top surface of the bottom slab and the exposed top surfaces of girders and diaphragms for at least 72 hours after the concrete has been placed. Immediately after the removal of the wet mats from these units, transparent or white pigmented membrane curing material shall be applied to all surfaces, except surfaces of construction joints, in accordance with [Sec 502.12.1](#) unless these items have attained the applicable strength specified in [Table I](#). The interior surfaces of girders and diaphragms shall be cured by leaving the forms in place for 5 days or by applying membrane. The membrane curing shall be in accordance with the requirements of [Sec 502.12.1](#) except that the membrane shall be applied with a brush or roller.

703.3.17.3 Light material and equipment, weighing less than 1000 pounds (450 kg), may be carried onto the bridge deck only after the deck concrete has been in place at least 24 hours, providing curing is not interfered with and the surface texture is not damaged. Vehicles needed for construction activities and weighing between 1000 and 4000 pounds (450 and 1800 kg), and comparable material and equipment loads, shall not be moved onto any span until after the last placed deck concrete has attained a compressive strength of at least 3200 pounds per square inch (22 MPa). Loads in excess of the above shall not be moved onto the bridge deck until the deck concrete has reached the compressive strength specified in the contract.

703.3.17.4 Structures shall not be opened to any public vehicular traffic until at least 14 days after the last placement of deck concrete and until such concrete has attained the compressive strength specified in the contract.

703.3.18 Scale Prevention Treatment. Bridge decks, except those which are to be surfaced later, shall be treated with one application of an approved mixture of equal parts, by volume, of commercially available double-boiled linseed oil and mineral spirits. The material shall be applied to the top surface of roadways, and the top and roadway faces of concrete sidewalks, curbs, parapets and medians. It shall be applied on a clean, dry surface of concrete that has been allowed to dry a minimum of 48 hours after curing mats have been removed and before the bridge is opened to other than essential construction traffic. Foreign material on the surface shall be removed and the ambient temperature shall not be below 35 F (2 C) at the time of application. The application of the mixture shall be at the rate of not less than 0.05 gallon per square yard (0.25 L/m²). The mixture may be sprayed or flowed on, or applied with an approved distributor, and shall be thoroughly broomed, brushed or mopped on all specified surfaces.

703.3.19 Hot Weather Concreting. When the weather forecast predicts temperatures of 90 F (32 C), or higher, the contractor shall schedule placing and finishing of bridge deck concrete during hours in which the ambient temperature will be lower than 90 F (32 C). The mixed concrete when placed in the forms shall have a temperature no higher than 90 F (32 C). The forms and reinforcing steel shall be cooled by acceptable methods, such as covering with wet burlap for at least 12 hours prior to the placing of concrete. The concrete shall be protected with wet curing mats as soon as it has hardened sufficiently to allow their placement.

703.3.20 Cold Weather Concreting. Concreting shall proceed on all structures, except bridge superstructures, whether or not heating is required, unless it can be definitely established that the overall progress of the project will not be affected. Placing of concrete in the superstructure of a continuous or monolithic series of spans once begun shall be continued within the provisions of cold weather concreting procedures until all the concrete in that series is placed. Concrete placed in cold weather shall be protected from freezing during the curing period by the use of a heated weatherproof enclosure. Concrete shall not be placed on frozen ground, nor against steel or concrete surfaces with temperatures lower than 35 F (2 C). No concrete shall be placed where the ambient temperature is below 35 F (2 C), and concrete in bridge superstructures shall not be placed where the ambient temperature is below 45 F (7 C).

703.3.20.1 The aggregates or water or both shall be heated during the season when the atmospheric temperature may drop below 40 F (5 C). Aggregates shall not be heated higher than 150 F (65 C). The temperature of the aggregates and water combined shall not be higher than 100 F (38 C) when the cement is added. Any method of heating during the mixing of concrete may be used, provided the heating apparatus will heat the mass uniformly and avoid hot spots which will burn the material. The temperature of the concrete at the time of placing in the forms shall not be lower than 45 F (5 C) for concrete in footings and massive piers and abutments, nor less than 60 F (16 C) for all other concrete.

703.3.20.2 Curing of superstructure concrete, substructure units above ground surface, retaining walls and box culverts of more than 15 square feet (1.5 m²) opening shall be within a weatherproof enclosure when the ambient temperature is below 40 F (5 C). Temperature within the enclosure shall be uniformly maintained between 40 F (5 C) and 80 F (27 C) for not less than seven days nor more than fourteen days. Heating may be discontinued after seven days provided the concrete has attained at least the applicable strength shown in [Table 1](#). When dry heat is used, at least 40 percent relative humidity shall be maintained. The contractor shall provide adequate fire protection at all times and shall maintain proper temperature and humidity conditions within the housing during the curing period. The exposed surfaces of the concrete shall be kept moist either by the application of steam or wet burlap mats. When curing is complete, the temperature within the enclosure shall be lowered gradually at a rate not to exceed 3 F (2 C) per hour, until the outside temperature is reached. Substructure concrete below ground surface may be protected by submersion provided the temperature of the water is maintained between 40 F (5 C) and 80 F (27 C) for seven days.

703.3.20.3 Insulated forms for cold weather protection may be used at approved locations in lieu of enclosures. The contractor shall secure written approval of the type of insulation, method of installation and the locations at which it is proposed for use.

703.3.20.4 Concrete headwalls for pipe culverts, drop inlets and box culverts of 15 square feet (1.5 m²) or less opening, may be placed without air temperature limitations, but the contractor is not relieved of his responsibility for proper protection from freezing during placing and curing of the concrete.

703.3.21 Extending and widening of existing concrete structures shall be in accordance with the details shown on the plans. A continuous groove at least one inch (25 mm) deep shall be sawed in the faces of the existing concrete as a guide for the line of break to prevent spalling. Surfaces of existing concrete which are to come in contact with new concrete shall be thoroughly cleaned, saturated with water and painted with a neat cement grout of painting consistency. The new concrete shall be placed immediately after the cement grout has been applied. If new concrete is to be placed against the natural finish of existing concrete work, the surface shall be roughened by bushhammering before being cleaned and treated. Before applying a new concrete riding surface, any existing bituminous surfacing shall be removed and the exposed concrete surface roughened by bushhammering before being cleaned and treated. No direct payment will be made for work incidental to joining new concrete to existing concrete.

703.3.22 Bridge numbers shall be stenciled in black paint on all concrete bridges. The letters shall be capitals not less than 2 inches (50 mm) nor more than 3 inches (75 mm) high. The bridge numbers shall be stenciled on concrete surfaces at two locations as directed by the engineer.

703.4 Method of Measurement.

703.4.1 Concrete masonry will be computed from the dimensions shown on the plans, or as revised in writing by the engineer, and will be computed to the nearest 1/10 cubic yard (0.1 m³) for each structure. No deduction will be made for the space occupied by reinforcing steel, conduit or piles. Deductions will be made for the space occupied by the tubes in voided slabs. Final measurement will not be made except for authorized changes during construction, or where appreciable errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from the contract quantity.

703.4.2 Measurement of concrete quantities in seal courses will be made for the actual yardage (quantity) placed, except that this yardage (quantity) will be limited to that included

within vertical planes 18 inches (450 mm) outside the neat lines of the footings proper, and to the maximum depth shown on the plans or as authorized by the engineer.

703.4.3 Measurement of concrete quantities used to fill cavities or crevices will be made for the accepted yardage (quantity) placed below the authorized elevation of the structure footing.

703.5 Basis of Payment.

703.5.1 The accepted quantity of concrete masonry, complete in place, will be paid for at the unit price for each of the pay items included in the contract.

703.5.2 The accepted quantity of concrete used to fill cavities or crevices below final authorized bottom elevation of the footing structure will be paid for based on the accepted quantity per cubic yard (cubic meter) at the fixed price specified in [Sec 109.14](#).

703.5.3 No direct payment will be made for incidental items necessary to complete the work unless specifically provided as a pay item in the contract. No direct payment will be made for concrete required to fill overbreak where footings or walls are cast against vertical faces of rock or shale excavation.